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Technical Guidance: Guidelines for th Preparation of Environmental Reports and Safety Evaluation Reports for In Situ Uranium Recovery Facilities

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

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TECHNICAL GUIDANCE: GUIDELINES FOR THE PREPARATION OF ENVIRONMENTAL REPORTS AND SAFETY EVALUATION REPORTS FOR IN SITU URANIUM RECOVERY FACILITIES

This document provides specific guidance for the preparation of environmental reports and safety evaluation reports for the licensing of in situ uranium recovery facilities, as required by Texas Health and Safety Code Chapter 401 (Texas Radiation Control Act) and 30 Texas Administrative Code (TAC) Section 336.1(7), which adopts by reference Part 43 of the Texas Regulations for Control of Radiation (TRCR) of the Texas Department of Health. If any of the topics addressed in this guide are not relevant to a particular project, the applicant should so indicate.

PART 1. ENVIRONMENTAL REPORT

I. Introduction

In situ uranium mining is subject to Texas Natural Resource Conservation Commission (TNRCC) licensing requirements, including monitoring, decommissioning, decontamination, and reclamation, in accordance with Health and Sefety Code Chapter 401 and the radiation rules in 30 TAC Chapter 336. In addition, in situ uranium mining is subject to TNRCC permitting requirements, including monitoring and restoration, in accordance with Texas Water Code Chapter 27 (Injection Well Act) and underground injection control rules in 30 TAC Chapter 331.

Certain geological and hydrological data are reviewed for both the licensing and the permitting of in situ uranium mining by the TNRCC. To minimize duplication of effort and avoid the need to prepare two distinct documents containing essentially the same information, an applicant for a TNRCC license should submit a copy of the TNRCC in situ mining permit application and supporting technical reports and (if prepared) the TNRCC application for the initial production area authorization. The license applicant should also submit (if prepared) the TNRCC application for a disposal well permit and supporting technical reports. These documents satisfy most geological and hydrological data requirements for TNRCC licensing and will be accepted as a part of the applicant's license application and environmental report. Geotechnical information required for the TNRCC license application but not included in the TNRCC mining permit application or reports (e.g., soils engineering data, radiological properties, etc.) should also be submitted in the TNRCC license application.

Regarding the scope of geotechnical/hydrological information required, the Executive Director recognizes that some of the

data described herein may not be developed prior to the formal application to the TNRCC for an initial production area authorization (which may occur well after both the TNRCC mining permit and TNRCC license have been issued). The geotechnical/hydrological information required to produce a minimal environmental assessment is essentially that required for permitting by the TNRCC. In the interest of enabling the Executive Director to make as thorough and accurate an evaluation as possible, however, it is requested that such additional information, if it has been developed, be submitted for review and incorporation into the environmental assessment.

Figures should be presented accurately, legibly, and unambiguously. A single map may be used for several purposes. Roadways, senderos, ponds, easements, and permit areas should be indicated. Each map, whether a full sheet or a partial sheet, should be accompanied by a legend that fully explains all symbols used. The legend should be presented preferably on the map border, but if it is lengthy or complicated, it may be presented separately in the text. Each map should indicate scale, orientation (north arrow), lines of latitudes and longitudes, and preparation date. Graphic scales are preferable to ratio or written scales because they are not altered by reproductive expansion or reduction. To facilitate comparison of maps and determination of spatial relationships, related or derivative maps should be of the same scale. For example, maps of surface geology, topography, soil types, and vegetative assemblages which contain related information will be more useful if they are all of the same scale. Likewise, maps showing well locations, formation or aquifer thickness, formation or aquifer structure contours, piezometric surfaces, etc. should be of the same scale.

United States Geological Survey (USGS) topographic maps and Texas county highway maps are available in standard scales at a nominal cost and make excellent base maps for data presentation. The USGS topographic maps are available from:

Branch of Distribution
U.S. Geological Survey
Federal Center
Denver, Colorado 80225

Texas county maps are available from:

Texas Department of Transportation
Transportation Planning and Programming
Division
P. O. Box 5051
Austin, Texas 78763-5051

County maps are also usually available from the office of the District Highway Engineer. Aerial photography is a superior method of depicting preoperational surface conditions as well as documenting changes during and after a project.

All topics below should be addressed to fulfill the requirements of the reports. If any of the topics are not relevant to the particular project, the applicant should so indicate. If any requested information is not available when the report is prepared, the applicant should indicate when it will be available. Each topic should be addressed with sufficient detail and documentation to permit the Executive Director to independently evaluate the environmental impacts and to prepare a safety evaluation report. The metric system of measurement with English equivalents should be used, except in those instances where the conventional English system is in general use.

A. Type of Activity

B. Proposed Activities - Present a brief, general description of the proposed project including: location of facility; mining methods to be employed; general process description; anticipated annual production; product storage; product transportation; disposal of solid and liquid wastes; expected life of project; and the proposed decommissioning, restoration, and reclamation plans, including surety arrangements.

C. Site Location and Layout - Provide a map that clearly indicates the location of the proposed project. Large- or intermediate-scale county maps from the Texas Department of Transportation are suitable for this purpose. This map should also show the county or counties, major drainages, transportation facilities, and cities within 16 km (10 mi) of the proposed project.

D. Site Ownership - Provide a list of names and addresses of owners of all surface and mineral rights within and adjacent to the TNRCC mining permit area(s). This list should correspond to a survey (ownership) map showing:

    1. The boundaries of the applicant's lease(s), the TNRCC mining permit area(s), and the proposed license area; and

    2. The location of adjacent properties.

    This map should also indicate the survey name(s), sections and block numbers for the TNRCC mining permit area(s), and the location of the proposed mine site(s).

The proposed restricted areas should be clearly marked on a map.

In addition, other existing and potential uses of the proposed licensed area and the acreages should be indicated.

Provide the names and addresses of all parties if the proposed activity to be licensed is a partnership or joint venture. With respect to the financial security required for decommissioning, decontamination, and reclamation, the applicant should detail any portion of the financial security being provided by any of the partners.

II. Area Information

Regional and site-specific radiological data should be reported. Include natural background levels and concentrations of radionuclides occurring in selected species of vegetation and animals, in soil and rocks, in air, and in surface water and groundwater. These data may be presented in the appropriate sections on air quality, geology, hydrology, and ecology. All data sources should be fully referenced. Nonradiological characteristics, particularly those that are similar to expected site-related contaminants, should be reported. Data should be presented on heavy metals and other potentially toxic substances, atmospheric pollutants, and dusts for which a potential for release to the environment will exist from the proposed facility and which could adversely affect water, soil, or air quality. Other regional sources of these substances should be considered in the discussion of the potential contribution to levels found at the proposed facility.

The programs for collecting baseline environmental data prior to submitting the license application should be adequate to assure that the applicant has made a thorough and comprehensive foundation for environmental assessment. The preoperational environmental monitoring program described in Appendix I may serve as a guide. The applicant's monitoring program should be fully described. In addition to a general description, provide maps of sampling locations and tabular summaries of such factors as sample collection and analysis frequencies; type of sampling; collection and sample preparation methods; analytical methods; and instrumentation and minimum sensitivities. The discussion should include the justification for the choice of sampling locations, analyses, and sampling frequencies.

A. Meteorology - This section should provide a description of the meteorological dispersion characteristics of the site and its surrounding area. The description should be based on data collected on site and/or at nearby local meteorological stations. Sufficient data should be included to permit independent evaluations and assessments of atmospheric dispersion characteristics.

The following data concerning site meteorology from meteorological measurements taken on site and/or at nearby representative stations should be provided:

1. Joint frequency data from the National Weather Service (NWS):

    a. Locations of all NWS stations within an 80 km (50 mi) radius;

    b. Available joint frequency distribution data by wind direction, wind speed, and stability class (three-dimensional numerical array);

    c. Period of record by month and year; and

    d. Height of data measurement.

2. Miscellaneous data:

    a. Annual average mixing layer heights; and

    b. Description (general) of regional climatology including frequencies and durations of extreme wind speeds.

3. Total precipitation and evaporation by month.

This information should be fully documented and substantiated as being representative of expected long-term conditions at or near the site.

The joint wind speed-stability-direction frequencies should be presented in tabular form, giving the frequencies as fractions when using five-year NWS summaries or as the number of occurrences when using only one or two years of onsite data. The data should be presented for each of the 16 compass directions, and the stability categories should be established to conform as closely as possible with those of Pasquill. In addition, the annual average inversion height should be provided from other nearby weather stations.

This section should also provide a discussion of general climatology, existing levels of air pollution, the relationship of the meteorological data gathered on a regional basis to local data, the impact of the local terrain and large lakes and other bodies of water on meteorological conditions in the area, and the occurrence and effects of severe weather in the area. Data on diurnal and monthly averages of temperature and humidity should also be provided.

B. Air Quality - Existing levels of air pollution and their relationship to the proposed operations should be discussed. Present data on airborne particulates and radon-222 (ambient concentrations and flux measurements) collected from the proposed license area during the preoperational monitoring program; these data should cover at least one annual cycle (see Appendix I). A copy of the air permit application to the Office of Air Quality of the TNRCC should also be submitted.

C. Regional Demography - Population figures based on the most recent U.S. Bureau of Census data should be presented. A map of suitable scale identifying cities, towns, and any other population concentrations (military bases, industrial complexes, etc.) within 80 km (50 mi) of the proposed facility should be given (with the radius centered on the process plant). Concentric circles should be drawn on the map at distances of 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70, and 80 km from the center point. The circles should be divided into 22 1/2 degree sectors, with each sector centered on one of the 16 compass points (N, NNE, NE, E, etc.). A table keyed to the map should indicate (see Appendix IV):

1. The residential population within each area for the expected first year of operations and for each year through the anticipated operational life of the facility; and

2. Separate and cumulative population totals for each sector and year.

Provide in tabular form the distance in each sector from the process plant to the nearest residence and site boundary. The method of obtaining the population projections should be described.

D. Socioeconomics and Land Use - Data on the economic base, housing, public services, public utilities, and transportation of the county in which the proposed facility will be located should be presented. Similar information should also be given for nearby counties and

communities that are likely to be affected by the proposed operations. The following topics should be addressed: the economy, utilities, public safety and health services, educational facilities, public finance, and transportation.

A land-use map of the area within 10 km (6.2 mi) of the proposed facility should be presented. The map may be based on half-scale or full-scale county highway maps or on other maps of equivalent scale. The map should indicate:

1. The major land use areas (ranchland, cropland, truck farms, dairy farms, mining, manufacturing, etc.); and

2. The location of airports, parks, wildlife preserves, surface reservoirs, etc.

E. Archaeological, Historic, and Scenic Resources - Provide a copy of a letter from the Texas Historical Commission (THC) concerning the historical and archaeological aspects of the project site. If an archaeological survey was required by the THC, provide a copy of the survey report. Scenic areas or unusual natural locales, if present on or near the proposed license area, should be discussed. Provide a list of sites recorded in the National Registry of Natural Landmarks, sites included or eligible for inclusion in the National Register of Historic Places, and public parks or wildlife preserves within 16 km (10 mi) of the proposed license area.

F. Geology

1. Topography and Surface Features - Provide, if available, a 7.5-minute USGS quadrangle sheet (1:24,000 scale) or equivalent on which the following features are shown and clearly labeled, as appropriate:

   a. The boundaries of the TNRCC mining permit area, the proposed license area, and the applicant's lease area;

   b. The area surrounding the proposed project to a distance of at least 3.2 km (2 mi) from the lease area boundary;

   c. The location of the proposed mine sites, the proposed processing site, and other proposed project structures;

d. The location and boundary of each anticipated restricted area;

e. Faults, if known or suspected; and

f. Any other pertinent features of topography or land use.

2. Surface Features - On one or more maps, indicate the following features for the area enclosed by a boundary 0.4 km (0.25 mi) outside the proposed TNRCC mining permit area or within the TNRCC area of review:

a. Mines (surface and subsurface) and quarries;

b. Petroleum production or processing facilities;

c. Communities and residences;

d. Highways and other roads, railways, and airfields; and

e. Pipelines and power transmission lines.

3. Regional Geology - Provide a description of the regional geologic setting of the project area. The description should be supported by appropriate maps, cross sections, stratigraphic columns, geophysical logs, etc. It should include brief discussions of geologic units, structural features, and the depositional and structural history of the area.

4. Site Geology - Discuss site geology in detail, emphasizing the ore zone and the underlying and overlying geologic and hydrologic units potentially affected by the mining operations. Discuss the general chemical nature, physical boundaries, and genesis of the ore body. Include the lithologic and depositional properties of geologic units and any variations of those properties across the proposed TNRCC mining permit area; thicknesses of units and, in particular, variations in thickness of the ore zone and adjacent underlying and overlying confining units; structural features; and other physical or chemical properties of rock units which might affect mining. The discussion should be supported by appropriate maps, cross sections, stratigraphic columns, interpreted geophysical logs, structure contour maps, isopach maps, etc.

5. Mineral Resources - Describe and locate on a map any resources within or adjacent to the proposed license area which might affect or be affected by the proposed mining operations.

6. Soils Engineering Data - Provide a U.S. Soil Conservation Service or equivalent map of the proposed license area and of the lease area(s) showing the distribution of soil types. Discuss the character of soils emphasizing:

   a. Engineering properties relevant to proposed construction; and

   b. Infiltration and drainage characteristics that might affect aquifer recharge or migration of contaminants caused by surface spills.

   Provide interpreted foundation boring information obtained in preparation for process plant construction.

7. Geologic Hazards Evaluation - Discuss the potential hazard to structures, operations, and the environment that might be caused by geologic phenomena. At a minimum, evaluate the impacts of the following hazards:

   a. Presence of active or inactive faults;

   b. Solution depressions or other surface or near-surface solution-collapse phenomena;

   c. Flooding; and

   d. Seismic risk (include a seismic risk map).

8. Preoperational Sampling - Provide a complete description, including locations, procedures, and analytical results, of the preoperational soil and sediment sampling program (see Appendix I).

G. Hydrology

1. Regional Hydrology - Provide a description of the regional hydrology, including major aquifers, hydraulic gradients, principal water quality indicators [total dissolved solids (TDS), sodium (Na^+), sulfate (SO_4^{--}), etc.], generalized groundwater flow directions, and other pertinent information. Locate areas of significant groundwater withdrawal. Include appropriate maps

and cross sections indicating the vertical and lateral limits of freshwater aquifers.

2. Site Hydrology - On a topographic map or maps [see Section II(F)(1)], locate surface drainages (perennial or intermittent), 100-year floodplains, and all surface bodies of water (stock ponds, fishing ponds, reservoirs, etc.) Delineate surface water divides and describe the paths of surface runoff from the proposed processing site and well fields into the regional drainage pattern.

   Provide an inventory of public and private water supply wells (including those used only for livestock or irrigation) within the area of review, if applicable, or within the area enclosed by a boundary positioned 0.25 mi (0.4 km) outside the proposed TNRCC mining permit area(s). The inventory should include, to the extent such data are reasonably available, the type completion, casing depth, bottom depth, aquifer pumped, water use, and water level elevation. Provide a map or maps locating and identifying the inventoried wells. On the map or maps include also the locations of in situ uranium well fields and associated disposal wells. Well fields may be shown by outline; individual wells within well fields do not need to be indicated.

3. Preoperational Sampling - Provide a complete description, including locations, procedures, and analytical results, of the preoperational groundwater and surface water sampling program (see Appendix I).

H. Ecology - Major native vegetation assemblages on the proposed license area and on the entire lease areas, if available, should be delineated on a map having the same scale as the soils map. A quantitative analysis should be conducted of native vegetation assemblages on areas to be directly affected by mining and processing activities. A list of vascular plant species on the proposed license area should be provided. Past disturbances of existing native vegetation assemblages (mechanical and chemical brush control, farming, etc.) should be described and the dates of such activities provided, if feasible.

   Vascular plants and vertebrates present on the proposed license area should be surveyed in the spring and in the fall. Summer and winter vertebrate surveys are also desirable. The estimated relative abundance of vertebrate species should be noted, and breeding

vertebrate species should be indicated. The types of livestock within the TNRCC mining permit area and within an area 8 km (5 mi) from the permit area boundary should be described and an estimate provided on the number of animal units present.

Vertebrate inhabitants in any surface waters should be surveyed. Macrophyte species in and wetland plants adjacent to each water body should be listed.

The proposed license area should be surveyed to determine whether any rare, threatened, or endangered species are present. Particular attention should be directed toward areas that will be disturbed by operations.

Biota should be sampled for bioassays (see Appendix I). Forage vegetation should be sampled at least twice (spring and fall) for analyses of natural uranium, radium-226, lead-210, and major nonradiological parameters. These samples should be collected near the soil sampling locations. Each species present in the vegetation samples should be identified, and the fraction of the total biomass and coverage attributable to each species should be estimated. Bioassays should also be performed for at least one herbivore (native rodent, native rabbit, game species, or domestic livestock). Fish, if present, from each surface water body should be collected semiannually, identified by species, and analyzed for radionuclide content (see Appendix I).

I. Gamma Radiation - Prior to initiation of facility construction, gamma exposure rate measurements should be made at the surface of soil sampling locations evenly spaced across the proposed licensed area and along its boundary (see Appendix I).

Measurements should be made at one meter above ground level with passive integrating devices [such as thermoluminescent dosimeters (TLD's)], pressurized ionization chambers, or portable survey instruments.

III. Proposed Operations

A. Mining Activities - Provide a thorough description of the various mining activities, including a topographical map showing locations and completion schedules of areas to be mined and the proposed operating schedule.

1. Well Completion - Describe the procedures for construction and completion of injection, recovery, and monitor wells. Include the following:

a. Total depth and completion interval selection criteria;

b. Type of completion (perforation, open hole, screen, etc);

c. Casing size, type, grade, weight, setting depth;

d. Tubing/packer system (if applicable);

e. Cement class, volume, type of additives, etc.;

f. Cementing technique;

g. Cementing equipment including guideshoe, float collar, plugs, basket, etc.;

h. Location and spacing of casing centralizers;

i. Drift control procedure;

j. Diagram for each type of well;

k. Well integrity testing procedures (well logs used, pressure testing, etc.); and

l. Development procedures (jetting, acid, etc.).

Describe in detail the hydrologic testing program, including test preparation, equipment, procedures, schedules, data analysis, a summary of test results (plotted curves, etc.), and test conclusions. Hydrologic testing should demonstrate the:

a. Degree of hydrologic connection between aquifers;

b. Location of flow boundaries and recharge structures;

c. Hydrologic connection between the production zone and the production zone monitor wells;

d. Confining nature of the upper aquiclude; and

e. Basic aquifer parameters and water availability.

2. Operating Parameters and Monitoring - Discuss the anticipated operations, including fluid injection rates, percent bleed, and injection pressures.

Indicate the anticipated mean chemical composition and range of constituents of injected fluids.

Provide a map showing the locations of all monitor wells, with each well identified by well number and classification (production zone, first overlying aquifer, etc.).

Provide for each aquifer a tabulation of the upper limit values of parameters used to determine the occurrence of excursions as defined by the TNRCC.

Discuss procedures for the prevention, detection, verification, and correction of excursions of leaching fluids in the production aquifer or into overlying aquifers. Include:

a. Monitoring schedule;

b. Procedures for taking, preserving, analyzing, and maintaining quality control of samples; and

c. Procedure for notifying appropriate state agencies.

B. Process Circuit - Discuss the uranium recovery circuit, including:

1. A description of the recovery facility (with a layout drawn to scale);

2. A description of the process circuit addressing the lixiviant sorption, resin transfer, and elution and precipitation circuits with a flow diagram giving design flow; and

3. The drying and packaging unit.

The information needed by the Executive Director to perform the radiological impact evaluations for the proposed facility is given in Appendix IV.

C. Site Preparation, Processing Facility Construction, and Well Field Opening - Organize the discussion in terms of the beneficial or adverse effects of site preparation (processing facility construction) and well field opening on land use and water use. Present information on the layout of buildings, roads, storage and disposal trenches, ponds, etc.; fire detection and suppression systems in any dryer building and/or laboratory; equipment to be used in the production process; and

equipment to be used for disposal of wastes. Provide a general description of preventive maintenance plans for the process circuit. The well field/recovery facility lixiviant transfer circuit should be discussed.

D. Management of Fluids and Wastes - Provide a material balance flow diagram identifying all wastes, their sources, and volumes.

Discuss the anticipated maximum volumes of fluids to be handled by storage and disposal facilities. Demonstrate that the design of the facility is adequate to safely handle the anticipated maximum fluid volume. Estimate waste fluid volumes for different phases of the project (full production, partial restoration, full restoration, etc.). The disposition of nonradiological and sanitary wastes should be discussed and plans provided for the proposed waste disposal facilities.

Describe the construction design of any waste storage ponds, sumps, or fluid waste storage facilities. Discuss leak detection, repair procedures in the event leaks are detected, and freeboard limits. Provide a design analysis of the proposed waste systems and schedule of preventive maintenance inspection for ponds, pipelines, trenches, dikes, storage areas, etc.

Describe procedures and structures to deal with leaks, spills, and runoff control.

If a waste injection well is planned, provide data sufficient to indicate that the proposed injection well system will be adequate to handle the fluid volume required and that it can be operated with minimal risk to ground and surface water. To satisfy the information requests of this part, the applicant may provide a copy of the injection well application technical report submitted to the TNRCC. At a minimum, include the following information:

1. The location of the well;

2. A description of the geology of the site pertinent to the proper siting, construction, operation, and closure of the injection well. The description should cover stratigraphy, structure, geomorphology, etc., and be supported as appropriate by maps, cross sections, well logs, or other illustrative material;

3. A well inventory and analysis of artificial penetrations within the area of review as required by the TNRCC;

4. A complete description of injection zone characteristics, including vertical and areal extent, lithology, and hydrologic parameters;

5. The design of the well, including construction materials and procedures and schedules for drilling, completing, and testing the well;

6. Description and justification for the requested pumping rates and volumes;

7. Details of monitoring; and

8. A plan for plugging the well.

E. Decommissioning, Decontamination, and Reclamation - Provide a closure plan and the other information listed below. These data will be used by the Executive Director to determine the financial security required for decommissioning, decontamination, and reclamation of the applicant's proposed facility.

1. Aquifer Restoration Program

a. Provide a description of proposed restoration procedures. Discuss the water quality criteria which should be met to achieve aquifer restoration.

b. Provide documentation of the effectiveness of the proposed procedure. Describe the results of any restoration tests or demonstrations and include both data and interpretations.

c. Describe how restoration progress will be documented and reported.

d. Provide a description of the fluid handling capacity of the proposed disposal facilities required to accomplish restoration, using the proposed procedure within the time frame of the mine plan.

e. Provide a schedule indicating the dates on which it is estimated that both production and restoration will be started and completed in each production area.

f. For each production area, provide:

(1) An accurate map showing the production area (well field) and associated mine area (within monitor well ring) and the tabulated area of each;

(2) A mean thickness or contacted thickness for the production zone aquifer within the production area (supported by isopach maps, cross sections, interpreted geophysical logs, etc.);

(3) Porosity of the production zone aquifer (indicating the source of this figure, such as logs, cores, etc.); and

(4) A projection of the number of pore volumes required to restore the production zone aquifer to appropriate (and specified) conditions. Projections should be based on the results of a restoration test or demonstration or on other data. The basis for the projections should be clearly cited.

2. Surface Decommissioning, Decontamination, and Reclamation

a. Provide a description of proposed procedures for decommissioning, decontamination, and reclamation of all well fields (including plugging of wells), waste storage ponds, the process circuit, all roadways, etc.

b. List the area of each proposed unit of the process circuit (e.g., resin transfer circuit, elution columns, precipitation unit, dryer, packaging unit, etc.), associated chemical storage tanks, laboratory, office, shops, warehouses, etc. Include surge tanks or satellite equipment in the well fields. This information may be presented with the plant layout in Section III(B).

c. List the proposed thickness of each concrete pad to be constructed for units of the process circuit and for other buildings and structures.

d. State the depth, area, and location of any caliche or other base which will be placed on

the well fields, recovery plant site, and roadways. Describe any plans to remove and dispose of this material.

e. State the surface area, mean depth, maximum depth (including freeboard), and total volume (including freeboard) of each waste storage pond.

f. Give the total proposed disturbed area at the plant site (including process facility, buildings, roadways, etc.) that will be revegetated.

g. Specify plant species and their relative proportion to be planted on disturbed areas to provide vegetative cover. Discuss the suitability of the soils for the plant species chosen. Describe revegetation techniques such as methods of planting, fertilization, and irrigation. The possible long-term effects of anticipated plant succession should be addressed.

h. Any commitments to the landowner (as contained in the lease agreement) that may affect the above items should be specifically addressed.

F. Alternatives to the Proposed Action - The applicant's choice of mining and processing methods should be supported by a comparative evaluation of alternatives. The applicant should explain the method for facility siting and the basis for selection of lixiviants and oxidants and for choice of methods for waste disposal, aquifer restoration, and surface reclamation.

IV. Operational Monitoring

Present the proposed operational monitoring program for planned operations. In addition to a general description, provide maps of proposed sampling locations and tabular summaries of such factors as sample collection and analysis frequencies, type of sampling, collection and sample preparation methods, analytical methods, and instrumentation, including minimum sensitivities. The discussion should include the justification for the choice of sampling locations, analyses, and sampling frequencies. The program described in Appendix II may serve as a guide.

Present criteria for setting threshold levels for corrective action. In the case of prescribed quantitative standards set by governmental agencies, cite the applicable regulations. In

the case of quantitative limits set by the applicant to conform to qualitative standards or restrictions, explain the rationale. In either case, if measurements exceed thresholds, specify the action to be taken.

A. Radiological Monitoring - The operational monitoring program for radiological effects should be described for the effluent monitoring program and for the environmental monitoring program.

1. Effluent Monitoring - The proposed effluent monitoring program, including the type, sensitivity, and reliability of instruments, and locations, frequencies, and analytical techniques, should be fully described. Identify monitoring procedures prescribed by local, state, or federal agencies as conditions placed on operations.

2. Environmental Monitoring - The environmental monitoring program should be described, with attention given to: types of samples to be collected; sample locations and frequency; analyses to be performed on each sample; analytical sensitivity (detection threshold) for each analysis; and criteria for investigating increases in concentrations of substances.

B. Other Monitoring Programs - Describe any additional meteorological and/or ecological monitoring to be conducted during operations. When the proposed project is located within 10 km (6.2 mi) of a uranium recovery facility, the applicant should attempt to identify and discuss the potential influence of that facility. Areas where monitoring programs overlap should be identified, and any plans for exchange of information should be presented.

When the site lies within a region for which environmental measurement or monitoring programs are carried out by public agencies, any programs known to the applicant should be identified and discussed. Relevance of such independent findings to the proposed facility's effects should be described, and any plans for exchange of information should be presented. Agencies responsible for the programs should be identified, and to the extent possible, the procedures and methodology employed should be briefly described.

V. Effects Of Accidents

Discuss accidents that might occur at the facility and during transport of materials to and from the facility. Analyses

should be based on experience and/or statistics from similar recovery and transportation operations. Discuss the statistical validity of the data and the rationale for applying the data to the proposed operations. Accidents caused by both humans and natural phenomena should be addressed.

A. Plant Accidents Involving Radioactivity - Provide accident analyses for a spectrum of accidents that might occur ranging in severity from minor releases (essentially no release of radioactive materials to the environment) to very large releases. Each class within the spectrum should be characterized by a probability estimate and its potential consequences. An example of a large-release accident would be a tornado striking the facility. An example of a small-release accident would be a fire or explosion in the process plant or failure of the air cleaning system serving the yellowcake area. An example of a minor accident would be the malfunction of recovery process equipment or the rupture of the lixiviant transport circuit with fluid migration.

B. Transportation Accidents - Potential environmental effects from transportation accidents involving radioactive and other hazardous materials should be evaluated. Provide adequate documentation to assure that all safety requirements will be met prior to the applicant's transportation of hazardous materials (e.g., spillage of hazardous chemicals, fuels, yellowcake, sulfuric acid). Measures taken to insure compliance with the U.S. Department of Transportation regulations for the shipment of radioactive material should be discussed.

C. Other Accidents - The potential environmental impacts of accidents such as chemical explosions or fires, steam boiler failures, and leakage or rupture of vessels containing toxic materials should be addressed.

VI. Environmental Impacts

The projected impacts of site preparation, facility operations, chemical discharges, and decommissioning, including restoration and reclamation, should be addressed.

A. Nonradiological Impacts

1. Air Quality - Address potential impacts on air quality associated with the proposed project. Concentrations of discharged nonradioactive effluents should be compared with background concentrations and with applicable standards.

Dilution and dispersion of releases and concentrations as a function of distance from discharge points should be provided.

2. Land Use - Describe changes from the original land use, temporary and permanent, resulting from the proposed project.

3. Groundwater and Surface Water - Discuss impacts on groundwater or surface waters associated with the proposed project. Describe the impacts of groundwater withdrawal resulting from operations and restoration.

4. Mineral Resources - Discuss the impact of the proposed project on regional mineral resources, including oil and gas production.

5. Soils - Discuss the impact on soils resulting from operations and reclamation. Emphasize the potential impact due to erosion and cleanup of the contaminated soil.

6. Biota - Describe potential impacts on flora and fauna in both terrestrial and aquatic habitats. Differentiate between short-term and long-term impacts to flora and fauna of acute and chronic exposures to effluents and disturbances.

7. Socioeconomic Impacts - Address socioeconomic impact of facility construction, operations, and decommissioning upon the local communities. Significant socioeconomic costs and benefits realized from the construction and operation of the facility should be discussed. The applicant should discuss significant costs to state and local governments which may result from the proposed project.

B. Radiological Impacts - The various possible pathways for radiation exposure of humans should be presented in flowchart format. Identify any points in exposure pathways where accumulation is likely to occur. Dose figures should be given in millirems, unless otherwise noted.

Estimate the expected annual mean concentrations of radionuclides and chemicals in surface waters that may receive discharges and in water that is consumed or otherwise used by humans or that is inhabited or utilized by species in human food chains. Specify the dilution factors used in preparing the estimates and the locations

where the dilution factors are applicable. Consider the absence of mixing and dilution because of factors such as channeling. Determine the expected radionuclide concentrations in aquatic and terrestrial organisms significant to human food chains.

Calculate the total annual body dose and significant organ dose to individuals in the population from all aquatic sources of internal and external exposure. Provide, as an appendix, details of the assumptions and methods used in these calculations.

From release rates of radon and particulates and from meteorological data, estimate the total annual body dose and significant organ dose to individuals exposed at:

1. The point of maximum ground-level concentrations off-site;

2. The project boundary in the direction of the prevailing wind;

3. The project boundary nearest the source of emissions; and

4. The nearest residence in the direction of the prevailing wind.

Make a similar estimate for individuals living in major population centers within 80 km (50 mi) of the site. Assume mean annual meteorological conditions. Identify locations of release points (e.g., stack, roof vent) used in calculations. Estimate deposition of radioactive materials on food crops and livestock forage. Estimate total annual body doses and significant annual doses received by other organs via such potential pathways. Estimate the maximum annual external dose that would be received by an individual at the nearest boundary of the proposed license area. Provide an appendix describing the assumptions and methods used in these calculations.

Provide estimates of the maximum annual doses that could be received by all identified pathways by an individual at the site boundary, at the nearest residence, and in a population center. Provide a tabular summary of the estimated radiation dose to the regional population (within 80 km, or 50 mi) from sources at the proposed facility, using values calculated in previous sections. The tabulation should include the total annual doses (in man-rems) to the population from all aquatic pathways and from airborne effluents. Effects related to radon and particulates should be described separately. Compliance

with 40 Code of Federal Regulations (CFR) 190 should be addressed.

Also, consider the impact of the radiological and chemical releases from the proposed project on biota other than humans. Since resident and migratory vertebrate species may occur in the region, species whose terrestrial and aquatic habitats are subject to the highest potential impacts should be emphasized.

If there are other components of the physical environment that may become contaminated, they should be identified and their impacts estimated. In addition, information concerning any cumulative buildup and maximum concentrations in the environment should be presented and discussed. A summary of assumptions, models, and data used in determining concentrations and impacts should be provided. Values of bioaccumulation factors used in preparing the estimates should be based on site-specific data if available; otherwise, values from the literature may be used.

Projected impacts from the proposed project should be compared with impacts from other nuclear fuel cycle facilities within 80 km (50 mi). The cumulative impacts of such facilities should be addressed.

VII. Resources Committed

Discuss irreversible commitments of resources that may be expected. Evaluate both relative and long-term net impacts, as well as absolute impacts. The areas addressed should include land and mineral resources, water and air resources, flora and fauna, and material resources.

VIII. Financial Security Arrangements

The applicant should provide a cost estimate plan for decontamination, decommissioning, restoration of aquifers, and reclamation of buildings and the land surface to radiation levels which would permit unrestricted use [see Section III(E)]. The specific instrument (e.g., cash, surety bond, letter of credit) should be indicated. Describe security requirements of other government agencies.

IX. Approvals of Other Agencies

List all licenses, permits, and other approvals or exemptions for construction and operations required by federal, state, regional, and local government agencies. Include copies of the approvals which have been received and indicate the status of those yet to be obtained.

X. Documentation and References

All sources of information used in the preparation of the report (books, articles, reports, maps, interviews, etc.) should be carefully documented. Illustrations (figures and maps) and tables should be labeled to indicate the sources of information used in their preparation. Every reference used should be cited at an appropriate point in the text. A reference list of all materials used in the preparation of the report should be presented, giving complete bibliographic information for each entry in a uniform format.

PART 2. SAFETY EVALUATION REPORT

This part outlines information the applicant should provide so the Executive Director can prepare the safety evaluation report.

I. Corporate Organization

Provide a description of the applicant's proposed organization, including authority and responsibility of each management level with respect to operating procedures, radiation safety programs, quality assurance programs, and routine and nonroutine maintenance activities.

II. Administrative Control

Describe the written operating procedures covering administrative control of activities at the facility. These procedures should be approved and reviewed periodically by the Radiation Safety Officer (RSO). Any nonroutine work or maintenance activity, such as decontamination of equipment, not covered by an operating procedure should be conducted in accordance with a special work permit reviewed and approved by the applicant's RSO.

III. Internal Inspection

Provide a description of programs which ensure that employee exposures to airborne and external radiation and effluent releases are as low as reasonably achievable (ALARA).

IV. Radiation Safety Program

Describe the minimum qualifications and experience required for personnel who will be responsible for developing and conducting the radiation safety program.

It is recommended as a minimum that the Radiation Safety Officer (RSO) have a bachelor's degree in engineering or

science, have attended an RSO's course, and have one year of experience related to uranium processing. The RSO should have the authority to cancel all or any part of the operation without prior management approval if a hazardous situation appears imminent. The RSO will be responsible for conducting the radiation safety program. A partial list of matters under the RSO's purview includes personnel training, records maintenance, establishment and maintenance of internal audit programs, contingency planning for emergencies, contamination surveys, personnel monitoring (including the bioassay program), special work permit reviews, and the respirator program.

V. Training

Describe the employee radiological protection training program, including the content of initial training, testing, on-the-job training, and extent and frequency of refresher training. Prepare a radiation safety manual to be issued to all employees. This manual should address the following topics:

A. Radioactivity, interactions with matter, and health effects;

B. Personal hygiene;

C. Surveys for contamination of personnel and equipment, and contamination surveys in laboratory, work, administrative, break room, lunch room, and shower/change areas;

D. Operation of personnel monitoring devices and respirators;

E. Operation of radiation detection and measurement instruments;

F. Housekeeping requirements;

G. Spill cleanup plans; and

H. Emergency actions in response to accidents.

VI. External Radiation Exposure Monitoring Program

Describe proposed instrumentation and methodology for determining employee exposures to external radiation. Describe the types of surveys to be conducted, criteria for determining survey locations, frequency of surveys, action levels, and corrective actions. Provide the number of personnel who will be monitored regularly with film badges,

TLDs, or other devices. It is recommended that all employees should be monitored for at least 30 days during the year. Describe survey instrumentation, instrument sensitivities, ranges, and calibration methods. Instruments should be calibrated at least every 12 months.

VII. Bioassay Program

Describe the bioassay program, which should be equivalent to or more stringent than the bioassay program in Appendix III.

It is recommended as a minimum that bioassays should be performed at least once per month on process plant personnel; quarterly on other operations and maintenance personnel; and at least annually on administrative personnel. Within 48 hours of a yellowcake packaging operation, a follow-up bioassay should be conducted on personnel involved. All bioassay results should be corrected to a standard urine specific gravity of 1.020.

VIII. Airborne Radiation Monitoring Program

Describe the proposed sampling program to determine concentrations of airborne radioactive materials (including radon) during routine and nonroutine operations, maintenance, and cleanup activities. The description of the sampling program should include the following:

A. The criteria for determining sampling locations with respect to process operations and personnel occupancy.

B. The frequency of sampling, types of analyses, sensitivity of sampling and analyses, action levels, management audits, corrective action requirements, and instrumentation calibration frequency. Procedures for sample analyses and instrument calibration should be included in an appendix.

In addition to bioassays required for employees working in the yellowcake precipitation and packaging areas of the plant, airborne particulate monitoring should also be carried out at least monthly as well as during special maintenance and decontamination operations.

IX. Contamination Control Program

Describe the proposed occupational radiation survey program to determine that employees entering clean areas (lunch rooms, offices, etc.) or leaving the site are not contaminated beyond 1,000 dpm/100 cm^2 removable alpha. The description should include proposed housekeeping and cleanup requirements, methods used in process areas to control contamination,

frequency of surveys of clean areas, and survey methods (swipes and/or survey instruments). The action level for clean areas and for release of materials, equipment, and work clothes to clean areas or from the site should be 1,000 dpm/100 cm^2 removable alpha. Prior to final disposal, contaminated equipment, filters, piping, resins, etc. should be placed on concrete pads surrounded by adequate berms.

X. Respiratory Protection Program

Describe the respiratory protection program to insure the protection of individuals who are exposed to airborne radioactive materials. This program at a minimum should include the following:

A. A written policy statement from management on respirator usage;

B. Air sampling and other surveys sufficient to identify the hazard, to evaluate individual exposures, and to permit proper selection of respiratory protective equipment;

C. Written procedures to ensure proper selection, supervision, and training of personnel using such protective equipment;

D. Written procedures to ensure adequate individual fitting of respirators and testing for operability immediately prior to each use;

E. Written procedures for proper maintenance of respiratory protective equipment; and

F. Records that will permit periodic evaluation of the respiratory protection program. It is important that an individual who is required to use respirators is physically able to perform the work. The medical status of individuals using respirators should be reviewed at least annually.

XI. Security

Describe the method for preventing unauthorized entry into the controlled area.

XII. Emergency Procedures

Describe contingency plans to handle a wide range of accidents from large, initially undetected spills/excursions to minor leakage of vessels. Describe measures to prevent or limit accidents and to notify the management and state agencies.

XIII. Transportation Accidents

Evaluate potential environmental effects from transportation accidents involving radioactive materials. Provide the driver(s) with instructions and training in preventing the spread of contamination in the event of a spill.

Each truck should be equipped with the proper shipping papers, response letter of identification and notification, a driver's contingency manual, and the following equipment in a weatherproof container:

A. Polyethylene sheeting (2,000 sq ft);

B. Shovels (2, short handle);

C. Disposable coveralls (3 pairs);

D. Rubber boots (3 pairs, mixed sizes);

E. Rubber gloves (4 pairs, mixed sizes);

F. Fiber tape (2 rolls);

G. Pocket knives (3);

H. Reflective warning signs and polyethylene guard rope; and

I. Respirators (3).

The driver(s) or civil authorities immediately on the scene should cover any spilled material with the sheeting. Sufficient protective clothing should be available for the work. Equipment and clothing should be wrapped in plastic after it is used for future decontamination. The site should be secured from unauthorized personnel, and civil authorities should be notified and briefed on the situation. The initial notification of company management and precautions taken should be enumerated in the response letter and the driver's manual.

XIV. Additional Information

Appendix IV is particularly pertinent to those facilities planning for a yellowcake drying operation.

XV. For More Information

This guidance is issued to assist TNRCC licensees and applicants in implementing and complying with specific parts of the radiation rules (30 TAC Chapter 336). Methods other than those presented in this guide may be proposed by the

licensee or applicant for approval. For assistance with any questions, please contact the UIC, Uranium, and Radioactive Waste Section, MC-131, Texas Natural Resource Conservation Commission, P.O. Box 13087, Austin, Texas 78711-3087, telephone number (512) 239-6065.

Appendix I

PREOPERATIONAL MONITORING OF IN SITU URANIUM RECOVERY FACILITIES[a]

TYPE OF SAMPLE	SAMPLE COLLECTION				SAMPLE
	Number	Location	Method	Frequency	Frequency
AIR					
Particulates[b]	2	Upwind and downwind of the proposed plant site at the location of the maximum calculated concentration	Continuous	Weekly filter change or more frequently as required by dust loading	Quarterly composite of weekly samples
	1	At the nearest downwind residence or occupied structure	Continuous	Weekly filter change or more frequently as required by dust loading	Quarterly composite of weekly samples
Radon	2	Same locations as air particulates	Depending on technique, 1 week or 48 hours per month repre-	1 sample per month	Each sample
		Same location as air particulates	senting the same period each month	1 sample per month	Each sample
Radon flux	1	Proposed plant site	Continuous	1 week per month	Each sample
WATER					
Groundwater	1 from each well	Potable, livestock, and irrigation water supply wells to at least 1 km outside license area boundary	Grab	Once	Each sample
	1 from each TNRCC[c] mining permit baseline well	As required by TNRCC mining permit	Grab	Once	Each sample

Appendix I

PREOPERATIONAL MONITORING OF IN SITU URANIUM RECOVERY FACILITIES[a]

TYPE OF SAMPLE	SAMPLE COLLECTION				SAMPLE
	Number	Location	Method	Frequency	Frequency
WATER (Continued)					
Surface water	1 from each impoundment and a minimum of 2 from each stream	Permanent impoundments and upstream and downstream in surface waters passing through license area: also adjacent impoundments subject to drainage from license area	Grab	Semi-annually	Each sample

[a] Conducted during the full year prior to license application
[b] Facilities with dryers (unless exempted from air permit requirements by Office of Air Quality of TNRCC
[c] Texas Natural Resource Conservation Commission

Appendix I

PREOPERATIONAL MONITORING OF IN SITU URANIUM RECOVERY FACILITIES[a]

TYPE OF SAMPLE	SAMPLE COLLECTION				SAMPLE
	Number	Location	Method	Frequency	Frequency
SOIL AND SEDIMENT					
Surface soil	1 per acre	Proposed plant site	Grab	Once	Each sample Samples collected in the two 22 1/2° downwind sectors
	1 per 5 acres	Proposed well field(s)	Grab	Once	Each sample Samples collected in the two 22 1/2° downwind sectors
	1 per 100 acres	License area	Grab	Once	Each sample Samples collected in the two 22 1/2° downwind sectors
	3	Radon sampling stations	Grab	Semi-annually	Each sample

[a] Conducted during the full year prior to license application

Appendix I

PREOPERATIONAL MONITORING OF IN SITU URANIUM RECOVERY FACILITIES[a]

TYPE OF SAMPLE	SAMPLE COLLECTION				SAMPLE
	Number	Location	Method	Frequency	Frequency
SOIL AND SEDIMENT (Continued)					
Subsurface soil	10% of well field samples	Proposed well field(s)	1-ft composites to depth of 3 ft	Once	Each sample 10% of samples or at least 1
Sediment	1 from each impoundment and a minimum of 2 from each stream	At surface water sampling locations	Grab	Once	Each sample
VEGETATION, FOOD, AND FISH					
Vegetation	1 per assemblage at radon sampling locations	Within license area 1 major grass/forb, 1 major shrub/brush, and 1 major food/feed crop	Grab	Spring and fall or harvest	Each sample
Food	1 (sample dependent)	Primary herbivore	Grab	When slaughtered	Each sample
Fish	1 from each body of water sampled as surface water	At surface water sampling locations	Grab	Spring and fall	Each sample

Appendix I

PREOPERATIONAL MONITORING OF IN SITU URANIUM RECOVERY FACILITIES[a]

TYPE OF SAMPLE	SAMPLE COLLECTION				SAMPLE
	Number	Location	Method	Frequency	Frequency
DIRECT RADIATION	Minimum of 25	At surface soil sampling locations evenly spaced across license area and at evenly spaced locations along license area boundary; measurements should be taken at 1 meter above ground level	----	Once	----

[a] Conducted during the full year prior to license application

Appendix I

PREOPERATIONAL MONITORING OF IN SITU URANIUM RECOVERY FACILITIES[a]

TYPE OF SAMPLE	SAMPLE COLLECTION				SAMPLE
	Number	Location	Method	Frequency	Frequency

[a] Conducted during the full year prior to license application

Appendix II

OPERATIONAL MONITORING OF IN SITU URANIUM RECOVERY FACILITIES

TYPE OF SAMPLE	SAMPLE COLLECTION				SAMPLE
	Number	Location	Method	Frequency	Frequency
STACK EFFLUENTS[a]	1 for each stack or vent	Each dryer stack and packaging vent	Isokinetic	Quarterly	Each sample
AIR					
Particulates[a]	2	Upwind and downwind of the proposed plant site at the location of the maximum calculated concentration	Continuous	At least 1 week per month	Quarterly composite of monthly samples
	1	At the nearest downwind residence or occupied structure	Continuous	At least 1 week per month	Quarterly composite of monthly samples
Radon	2	Same locations as air particulates	Depending on technique, 1 week or 48 hours per month representing the same period each month	1 sample per month	Each sample
	1	Same location as air particulates		1 sample per month	Each sample
PROCESS FLUIDS	1 for each surge tank	Surge tanks in well fields and processing area	Grab	Quarterly	Each sample
WATER					
Groundwater	1 from each well	Potable, livestock, and irrigation water supply wells within the license area	Grab	Quarterly	Each sample

Appendix II

OPERATIONAL MONITORING OF IN SITU URANIUM RECOVERY FACILITIES

TYPE OF SAMPLE	SAMPLE COLLECTION				SAMPLE
	Number	Location	Method	Frequency	Frequency
WATER (Continued)					
Surface water	1 from each impoundment and a minimum of 2 from each stream	Permanent impoundments and upstream and downstream in surface waters passing through license area: also adjacent impoundments subject to drainage from license area	Grab	Quarterly and after rain, if possible	Each sample
SOIL AND SEDIMENT					
Soil[a]	3	At air particulate sampling locations	Grab	Quarterly	Each sample
	3	At radon sampling locations	Grab	Annually	Each sample
Sediment	1 from each impoundment and a minimum of 2 from each stream	At surface water sampling locations	Grab	Annually	Each sample
VEGETATION, FOOD, AND FISH					
Vegetation[a]	3	At air particulate sampling locations	Grab	Annually (during growing season)	Each sample
	3	At radon sampling locations	Grab	Annually (during growing season)	Each sample

[a] Facilities with dryers (unless exempted from air permit requirements by Office of Air Quality of the Texas Conservation Commission)

OPERATIONAL MONITORING OF IN SITU URANIUM RECOVERY FACILITIES

TYPE OF SAMPLE	SAMPLE COLLECTION				SAMPLE
	Number	Location	Method	Frequency	Frequency
Food	1 (sample dependent)	Primary herbivore within license area	Grab	Every 2 years	Each sample
Fish	1 from each body of water sampled as surface water	At surface water sampling locations	Grab	Annually	Each sample
DIRECT RADIATION	4	At radon sampling locations and 1 at nearest unrestricted perimeter	----	Quarterly	----

[a] Facilities with dryers (unless exempted from air permit requirements by Office of Air Quality of the Texas Conservation Commission)

Appendix III

BIOASSAY PROGRAM FOR URANIUM PROCESSORS

I. Persons to be Monitored - Bioassays should be performed for all workers who are routinely exposed to airborne yellowcake dust or uranium ore dust. Bioassays should also be performed for any worker temporarily exposed to excessive levels of yellowcake or uranium ore dust, such as may occur when maintenance work is performed in high dust areas.

II. Type of Bioassay - Bioassays should be performed by urinalysis capable of detecting the uranium content of the urine with a sensitivity of at least five micrograms uranium per liter (5 µg/l) of urine. Results should be obtained within 20 days of the collection. If an outside laboratory is used, results exceeding 30 µg/l should be reported by telephone.

III. Frequency of Bioassay - Bioassays should be conducted at least once each month for workers routinely exposed to uranium dust. Workers temporarily exposed should have a bioassay sample collected 2 to 4 days after exposure to the airborne uranium.

IV. Actions Based on Bioassay Results - A value of 30 µg/l under equilibrium conditions is considered the limiting value a worker may have for chemical toxicity. A value of 130 µg/l obtained within 2 weeks following a single intake of yellowcake indicates a value sufficiently large to cause kidney damage according to the United States Nuclear Regulatory Commission. In view of this, the following actions will be taken:

A. Less than 15 µg/l - None

B. 15 to 30 µg/l -
   1) Confirm results (repeat urinalysis);
   2) Attempt to identify cause of high exposure; and
   3) Take corrective measures and/or limit worker exposure.

C. Greater than 30 µg/l -
   1) Take actions as given above for 15-30 µg/l;
   2) Remove worker from high dust area until bioassay is 15 ug/l or less; and
   3) Notify the Executive Director in writing.

D. Greater than 30 ug/l for four consecutive bioassays or greater than 130 ug/l for any one test -
   1) Take actions given above; and
   2) Have additional urine samples tested for albuminuria.

V. Prevention of Specimen Contamination - Specimens should normally be collected within 2 days after a worker returns to work from the weekend or from his/her days off. Specimens should be collected at the beginning of a work shift in an area free of uranium contamination and prior to the worker entering the restricted area. Clean, disposable containers should be used and the worker will be instructed to wash his/her hands carefully prior to voiding.

VI. Analysis - Specify who will analyze the bioassays (name of commerical laboratory or licensee). If the licensee is to analyze the bioassays, procedures for such analysis should be given.

VII. Quality Control - The bioassays should be processed along with known control specimens of 15 µg/l and 30 µg/l to provide a means for assuring the accuracy of the tests.

Appendix IV

INFORMATION NEEDED BY EXECUTIVE DIRECTOR TO PERFORM RADIOLOGICAL IMPACT EVALUATIONS FOR COMMERCIAL-SCALE IN SITU URANIUM SOLUTION MINING FACILITIES

1. Provide a detailed site plot plan (overlaid on topographic map, with scale and true north arrow) clearly identifying all locations of:

    a. Site property boundaries;
    b. Restricted area boundaries, if different from site property boundaries;
    c. All radiological effluent release points (or areas) such as:

        (1) Production wells,
        (2) Yellowcake drying and packaging area emission stacks or vents (if applicable),
        (3) Evaporation, settling, or any other solid/liquid disposal pond areas, and
        (4) Any other release points of emission to the atmosphere, e.g., surge tanks, process building vents;

    d. Lands owned, leased, or otherwise controlled (including mill site claims) by the applicant;
    e. Lands usable and available for grazing;
    f. Private residences or other structures used by the general public;
    g. Vegetable or other crops, identified by type and growing season;
    h. Milk animals (cows or goats); and
    i. Ownership of adjacent plots.

2. All locations of sources and receptors should be given in terms of distances from a central release point. Coordinates relative to this release point should be given as follows:

    a. X kilometers east or west of the central release point;
    b. Y kilometers north or south of the central release point; and
    c. Z meters elevation from the base of the central release point.

    (Note: Locations to the south and/or west should be denoted by a negative value. Any recognizable facility will suffice as a central frame of reference, but largest source should be used.)

INFORMATION NEEDED BY EXECUTIVE DIRECTOR TO PERFORM RADIOLOGICAL IMPACT EVALUATIONS FOR COMMERCIAL-SCALE IN SITU URANIUM SOLUTION MINING FACILITIES

Identify and locate on a map any nuclear fuel cycle facilities within 80 km (50 mi) of the proposed license area.

Table 1 lists the types of sources and receptors and the format suggested for reporting the locations requested.

Table 1

Locations	East(x) (km)	North(y) (km)	Elevation(z) (km)
Sources			
1. Yellowcake dryer	__	__	__
2. Surge tank(s)	__	__	__
3. Solid/liquid disposal areas	__	__	__
4. Production wells	__	__	__
5. Other sources, if applicable	__	__	__
Receptors			
1. Nearest resident	__	__	__
2. Nearest resident in prevailing wind direction	__	__	__
3. Agricultural site(s)*	__	__	__
4. Town(s)	__	__	__
5. Other nearby residents or industrial or recreational facilities	__	__	__
6. Restricted area boundaries (N, S, E, W, NE, SW, SE, NW)	__	__	__

* may be ranches, farms, orchards, grazing areas, or gardens

INFORMATION NEEDED BY EXECUTIVE DIRECTOR TO PERFORM RADIOLOGICAL IMPACT EVALUATIONS FOR COMMERCIAL-SCALE IN SITU URANIUM SOLUTION MINING FACILITIES

3. Give a time-sequenced bar graph describing various stages of the facility's operational and postoperational life. This should include any alterations relating to the sources of emission such as operation, restoration, or termination. Changes in exposed areas in evaporation ponds should also be indicated.

4. The following parameter values should be provided (if there are changes in Part 3 above, multiple corresponding values for each stage should be reflected here):

Parameter	Value
Average ore quality, U_3O_8, in ore body	_____%
Ore activity, U-238, U-234, Th-230, Ra-226, and Pb-210	_____pCi/g
Operating days per year (plant factor)	_____days
Dimensions of the ore body or bodies	
Area of each ore body	_____acres
Average thickness of body (bodies)	_____m
Acres per year to be mined	_____acres
Average production flow rate	_____gpm
Formation porosity	_____%
Process recovery	_____%
Leaching efficiency	_____%
Rock density	_____g/cm^3
Restoration flow rate	_____gpm
Production well parameters	
Residence time	_____days
Type of well pattern (5, 7 spot, or other)	_____
Radius	_____m
Average well pattern flow rate	_____gpm
Number of well patterns	_____
Annual Rn-222 emission from production	_____Ci/yr
Annual Rn-222 emission from restoration	_____Ci/yr
(Note: If the Rn-222 is not measured, indicate the complete calculational methodology, providing all assumed parameter values and references.)	
Yellowcake drying and packaging data (if applicable)	
Processing rates for drying and packaging if different	_____MT/hr
Estimated annual yellowcake production rate	_____MT/yr
Expected yellowcake purity, U_3O_8 by weight	_____%

INFORMATION NEEDED BY EXECUTIVE DIRECTOR TO PERFORM RADIOLOGICAL IMPACT EVALUATIONS FOR COMMERCIAL-SCALE IN SITU URANIUM SOLUTION MINING FACILITIES

Parameter		Value
Any measured airborne effluent concentrations		_____Ci U-238/yr
		_____Ci Th-230/yr
		_____Ci Ra-226/yr
		_____Ci Pb-210/yr
Stack heights and airflows	Drying	_____m, m^3/s
	Packaging	_____m, m^3/s
	Surge Tank	_____m, m^3/s
Anticipated release rates for dryer stack, the packaging area ventilation exhaust, and any yellowcake storage area ventilation exhausts	Dryer Stack	_____kg/hr
	Packaging Stack	_____kg/hr
	Other	_____kg/hr
Drying and packaging operations are carried out		_____hr/day and days/yr
Description of all ventilation air filtration equipment with design, expected, and minimum efficiencies (if applicable)		(Attach sheet)
Filtration equipment testing procedures and frequencies		(Attach sheet)
Solid/liquid disposal impoundments, e.g., evaporation ponds		(Attach sheet)
Complete physical, chemical, hydrological, and radiological description of disposal impoundment system.		
Total area of each impoundment area and surface areas expected to be underwater, saturated, moist, and dry (indicate surface moisture contents used as basis of estimates).		
Anticipated Rn-222 release rates for surface areas underwater, saturated, moist, and dry, Ci/yr per m^2.		

If not included above, please provide the following:

Total dissolved solids in liquid waste	_____g/l
Activity of solids in impoundments	_____pCi U-238/g
	_____pCi Th-230/g
	_____pCi Ra-226/g
	_____pCi Pb-210/g
Activity in liquids in impoundments	_____pCi U-238/l
	_____pCi Th-230/l
	_____pCi Ra-226/l
	_____pCi Pb-210/l
Density of solids	_____g/cm^3

INFORMATION NEEDED BY EXECUTIVE DIRECTOR TO PERFORM RADIOLOGICAL IMPACT EVALUATIONS FOR COMMERCIAL-SCALE IN SITU URANIUM SOLUTION MINING FACILITIES

5. Meteorological Data

Give the annual joint relative frequency distributions of wind direction and wind speed by atmospheric stability class as follows (see Table 2):

a. Wind direction to be given in the 16 compass directions;

b. Wind speed to be given in knots in the indicated classes (i.e., 0-3, 4-6, 7-10, 11-16, 17-21, over 21); and

c. Atmospheric stability to be given in the following manner:

A - Extremely unstable
B - Moderately unstable
C - Slightly unstable
D - Neutral
E - Moderately stable
F - Very stable

Table 2

Stability Class	Wind Speed Class (knots)					
Wind Direction	0-3	4-6	7-10	11-16	17-21	Over 21
N						
NNE						
NE						
ENE						
E						
ESE						
SE						
SSE						
S						
SSW						
SW						
WSW						
W						
WNW						

NW
NNW

INFORMATION NEEDED BY EXECUTIVE DIRECTOR TO PERFORM RADIOLOGICAL IMPACT EVALUATIONS FOR COMMERCIAL-SCALE IN SITU URANIUM SOLUTION MINING FACILITIES

d. Regional Data (Within 80 km) (Attach sheet)

(1) Give the population distributions by direction (16) and radius (1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70, and 80 km) for a recent year (no earlier than 1970) and for the last year of expected operations (see Table 3 for reporting table format).

(2) Give the available county food production data, in kg/yr, for vegetables (by type and totals), meat (all types), and milk; if available, include any future predictions by local governmental or industrial or institutional organizations.

6. Miscellaneous

If not included above, please provide:

Percent of year during which cattle graze locally	_____%
Percent of cattle feed obtained by grazing	_____%
Percent of stored cattle feed grown locally	_____%
Acreage required to graze 1 animal unit (450 kg) for 1 month (AUM)	_____ha
Length of growing season	_____mo/yr
Percent of locally-produced vegetables consumed locally	_____%
Percent of locally-produced meat consumed locally	_____%
Percent of locally-produced milk consumed locally	_____%

INFORMATION NEEDED BY EXECUTIVE DIRECTOR TO PERFORM RADIOLOGICAL IMPACT EVALUATIONS FOR COMMMERCIAL-SCALE IN SITU URANIUM SOLUTION MINING FACILITIES

Table 3

	Population Distribution													
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW
Kilometers	0.0	22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0	202.5	225.0	247.5	270.0	292.
1.0- 2.0														
2.0- 3.0														
3.0- 4.0														
4.0- 5.0														
5.0-10.0														
10.0-20.0														
20.0-30.0														
30.0-40.0														
40.0-50.0														
50.0-60.0														
60.0-70.0														
70.0-80.0														